

H E A L T H

Technologies for Better Quality of Life

MEDICAL INSTRUMENTS

In its effort for import substitution, BARC had initiated development of nuclear medical and bio-medical instruments almost forty years back. To name a few, Thyroid Uptake Monitor, Renogram, Slow Gamma Scanner, Fast Gamma Scanner, were the nuclear medical systems developed and supplied to majority of the nuclear medicine centres in the country and Electromyograph, Quantitative EMG Analyser, Impedance Plethysmograph, M-mode Echo Cardiograph, Magnetic Stimulator were the bio-medical instruments developed and supplied to various medical institutions. Some of these systems are still in use in their original form.

Impedance Cardio-vasograph Cardiac Output Monitor, Gamma Camera Data Acquisition System and Medical Analyzer are some of the activities that are currently being pursued. These instruments are clinically evaluated at places like KEM hospital, J.J. Hospital, Radiation Medicine Centre and BARC Hospital, with control subjects and patients. Cardio-vasograph is already in routine use at the Department of Medicine, J.J. Hospital. The technology for Cardio-vasograph and the Cardiac Output Monitor has been transferred to M/s Larsen & Toubro recently. Eighty units of Gamma Camera and Data Acquisition Systems have been supplied to different nuclear medicine centres in the world under the IAEA programme. Some of the above systems are described here.

Impedance Cardio-vasograph

Impedance Cardio-vasograph is an innovative way to track cardio-vascular ailments non-invasively. The instrument measures electrical impedance of any segment of body using constant current method. Pulsatile blood volume changes in the body segment, synchronous with every cardiac ejection, cause pulsatile changes in the electrical impedance of the segment.

These changes in impedance as a function of time $DZ(t)$ or rate of change of impedance dZ/dt , yield relevant physiological information. These signals are serially linked to PC through an intelligent interface. The system has several unique features that are not available from any of the systems available from abroad such as simple, reliable and built in calibration, normalized dZ/dt

waveform for easy interpretation and differential pulse arrival time for differentiating between occlusion and narrowing.



Cardio-vasograph

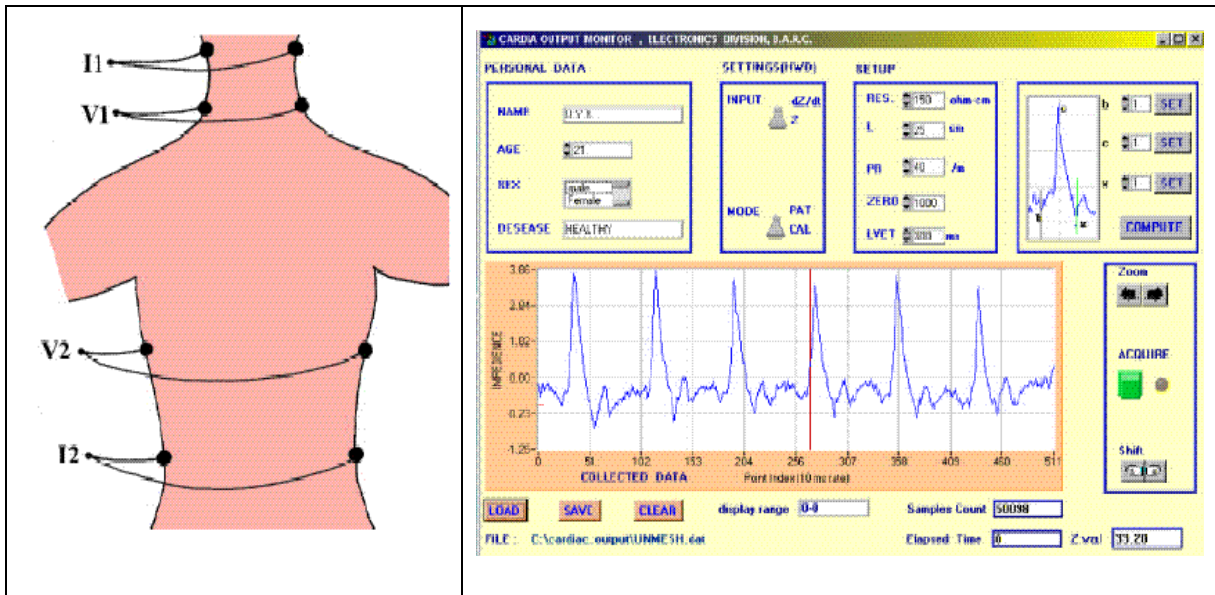
The instrument can be used for the diagnosis of aortic and arterial occlusive diseases, deep vein thrombosis and primary/secondary varicosity of veins. It can also be used for the assessment of valvular diseases of the heart, congenital septal disorders, cardiac function in ischaemic heart disease, pulmonary congestion in respiratory disorders and therapeutic response in all above conditions.

Medical fraternity in the country is to be made aware of this development in order to reach the benefit to the common masses. This technique needs to be popularized by organizing workshops, free camps etc.

Cardiac Output Monitor

Cardiac Output Monitor Employs principle of impedance plethysmography for continuous monitoring of cardiac output non-invasively. Constant amplitude sine wave current is passed between electrodes I1 and I2 and voltage signal developed along the current path is sensed with the help of electrodes V1 and V2. This signal is used to derive base impedance(Z_0) of the thoracic region and rate of change of impedance caused by ejection of blood by the heart. These signals are used to obtain Stroke Volume (SV) and Cardiac Output (CO) using Kubicek's formula.

This is the only noninvasive method for continuous monitoring of cardiac output and can easily be integrated with patient monitors in intensive care units and intensive cardiac care units. It is required to compare the results of the system with other invasive methods and validate this use of this method.



Medical Analyzer

Medical Analyzer is a simple and in-expensive instrument to study the variabilities of physiological parameters, such as Heart Rate, Respiration Rate, Peripheral Blood Flow and Cardiac Output. Medical Analyser uses principle of impedance plethysmography for recording dZ/dt waveform from the chest/wrist of the subject to derive heart rate, respiration rate and cardiac output/ peripheral blood flow as a function of time. The Fourier Transform of these functions yield variability in the heart rate, respiration rate and peripheral blood flow / cardiac output, useful in the assessment of the autonomous nervous system, by single lead data acquisition from the subject.



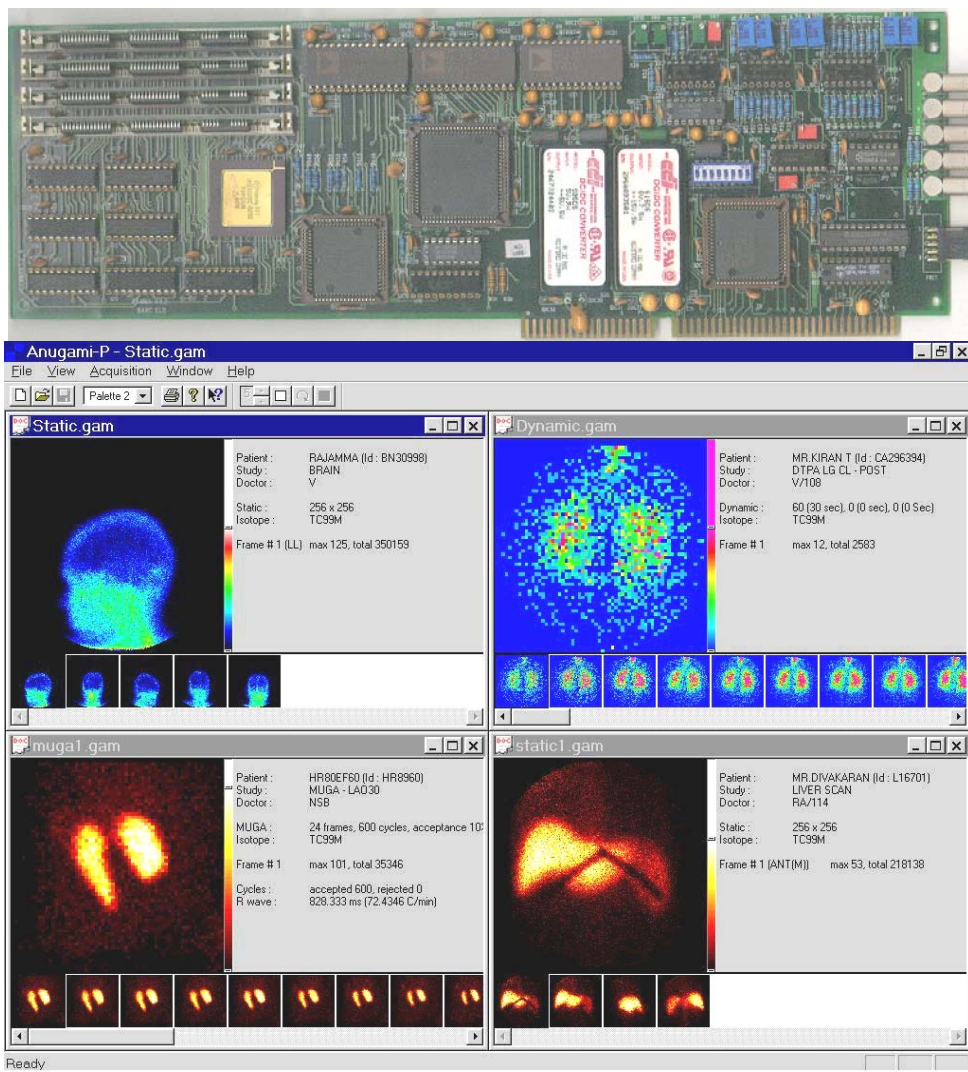
Medical Analyzer

'Medical Analyzer' is likely to become a very powerful research tool. This instrument provides a scientific basis for the 'Nadi Pariksha' practiced by many of the Indian physicians. The instrument analyses the variations in blood flow rates from the wrist of a subject in frequency domain. The initial study conducted over some three hundred patients has shown very promising results – it is observed that there are characteristic modifications in the variability for different diseases. At some stage an instrument can be derived out of this tool which will be able to diagnose several diseases simultaneously.

Anugami-P Gamma Camera Data Acquisition System

Anugami-P is a Transputer (T425) based intelligent PC add-on card. It accepts x, y position signals, z energy signal and ECG pulse along with synchronizing signal. Three sampling ADCs are used (conversion time 800ns) for digitizing x, y and z signals. A motor control interface is provided to control the rotation of detector assembly and reading the position feedback.

The software supports Static, Dynamic, MUGA and SPECT studies. The quality of online images is improved by applying the energy correction, uniformity correction and linearity corrections. The software provides integrated environment to perform the studies, display images and store them in different standard file formats. The reports can be generated either on printers or X-ray plates.



Anugami-P is a gamma camera data acquisition system developed to revive old GE gamma cameras in the Radiation Medicine Centre (RMC), Parel. The old and obsolete PDP computers, image acquisition and correction modules of the GE gamma cameras were also replaced by Anugami-P. It is also installed at Electronics Corporation of India (ECIL) in Hyderabad, All India Institute of Medical Sciences (AIIMS) in New Delhi, Institute of Nuclear Medicine and Allied Sciences (INMAS) in New Delhi, B.J. Medical College in Pune and International Atomic Energy Agency (IAEA), Vienna.

It is proposed to upgrade some of these technologies as web enabled , embedded medical systems with inbuilt artificial intelligence. Also some of the most commonly used instruments such as Three Channel ECG, Holter Monitor etc. have to be developed/upgraded indigenously with latest technology and Artificial Intelligence. These systems are proposed to be clinically validated with the help from premier Medical Institutes such as the All India Institute of Medical Sciences, New Delhi, Shri Chitra Thirunal Institute of Medical Science and Technology, Trivandrum, SN Medical College and Hospital, Agra, Grant Medical College and JJ Hospital, Mumbai, for wider acceptance of the same in and outside the country.

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